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FEBRUARY 29, 1988

CHEMICAL & ENGINEERING

NEWS

Federal R&D Budget '89

Administration seeks increase despite deficit problems
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CHEMICAL & ENGINEERING NEWS

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FEBRUARY 29, 1988

News of the Week

■ **Presidential Commission on AIDS issues first national policy recommendations, urging speedup in drug development, health care, and IV drug abuse treatment and prevention.** **Page 4**

■ **Court rules that Occidental Chemical Corp. must pay for Love Canal cleanup, estimated at about $250 million.** **Page 5**

■ **New test for AIDS antibodies developed by SmithKline Beckman will reduce or eliminate false positive tests, the company says.** **Page 5**

■ **NSF survey finds that high percentage of primary and secondary school science and math teachers are poorly trained and that many feel unqualified to teach these subjects.** **Page 6**

■ **Despite continuing Congressional opposition, the Administration persists in its efforts to privatize the National Technical Information Service.** **Page 6**

Business

Canada's four major chemical firms ended 1987 on high note, with combined profits climbing 70%, sales 20% in fourth quarter. **Page 15**

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Government

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"Invisible Frontiers: The Race To Synthesize a Human Gene" by Stephen S. Hall provides insights on the establishment of the biotechnology industry. **Page 27**

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News Focus

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Chemical & Engineering News

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LETTERS

Frontier research cooperation

SIR: I read with great interest on the editorial page (C&EN, Jan. 4, page 5) excerpts of the speech by Rep. Sherwood L. Boehlert (R.-N.Y.) on the Superconducting Super Collider (SSC) before the assembled physicists.

Boehlert made a number of fundamental statements with extraordinary clarity. He said, "I support the SSC because I think human beings must continue to probe the nature of matter, to understand the forces that affect our lives. I believe that the U.S. has an obligation to push that quest forward.... An SSC cannot credibly be promoted as a device to promote economic competitiveness.

"The reasons for my discomfort with the SSC are easier to state. They can be boiled down to one word: money.... The best way to limit the cost of the SSC to the U.S. is to entice other nations to contribute. Yet [the Department of Energy] seems singularly unenthusiastic about this prospect. The reasons for this are unclear. Department officials repeat the phrase 'an American project within American borders' with mind-numbing frequency, as if it were some sort of mantra.

"The reality is that if the U.S. is going to engage in 'big science' it simply cannot afford to 'go it alone.'"

In a few short sentences, Boehlert succinctly summarized the economic reality of frontier research in all areas of science—space, molecular biology, astronomy, immunology, ecology, microelectronics, bioengineering, etc.—not just of high-energy physics. He also provided the most obvious as well as the logical solution: international cooperation. He correctly implied that full participation in frontier research is a responsibility of all civilized nations; we cannot shirk it. Human civilization is indivisible and its progress must be without interruption.

Both the capitalist and the socialist countries can fully participate in these endeavors and avoid economic waste, needless duplication, and the reinvention of the wheel. For example, the U.S.S.R. is decidedly better in rocketry and space-station hardware than we are, whereas we are well ahead of them in microelectronics and computing. Cooperation will benefit both nations. Such cooperation will also build confidence in each other.

The problem is that most frontier research has direct or indirect military implications, and therefore the military of every nation is always irreconcilably against such international cooperation. Boehlert should know that the Department of Energy is interlocked with military and that should explain DOE's strange mantra chanting. Historically, military's goal is dominance over others and not fraternity with others. Therefore, as long as the arms race continues, the doctrine of "position of strength" is adhered to, and ideological zealotry is propagated, genuine international cooperation is theoretically impossible, and mankind plunges toward economic ruination. Signs are quite visible.

Buddhadev Sen
Emeritus Professor of Chemistry
Louisiana State University

Support for risk communication

SIR: The National Science Foundation has asked us to clarify that our center, which is studying risk communication (C&EN, Oct. 26, 1987, page 22), is a Carnegie Mellon University Center. Much of the work we are doing in this center is supported by NSF, but NSF has not made a "center grant" to us in this area.

M. Granger Morgan
Head, Department of Engineering and Public Policy
Carnegie Mellon University

Ozone layer rejuvenation

SIR: Leon Sadler (C&EN, Nov. 9, 1987, page 2) proposes to solve the ozone depletion problem by using airplanes or other techniques to carry ozone upward for stratospheric release. He calculates the total mass of pure ozone to be 3.3×10^{12} kg and then suggests that if there is a 6% depletion over 100 years, only 5.4×10^{6} kg per day would be needed to make up the deficit. Because this is only 2% of the U.S. airline freight load, Sadler suggests that ozone depletion has a ready technological solution. Were ozone like water sitting in a tank with a very small leak, Sadler's analysis would be correct. Ozone, however, and the atmosphere, are very dynamic. In the upper tropical stratosphere the lifetime of an individual ozone molecule is very short (seconds) and despite plausibly rapid ozone additions, the system would return to a perturbed equilibrium state determined by the amount of odd chlorine, nitrogen, and other species that catalytically control ozone abundance. In addition, it is at these altitudes where ozone depletion can be tens of percent, not just a few percent.

At lower stratospheric altitudes, the ozone created at higher altitudes is mov-

Funds for R&D Are Up 4% in Administration's Budget Proposal

NSF budget would rise 19%, putting the agency back on the track of doubling its funding over five years, whereas the rapid expansion in defense R&D would be halted, at least temporarily

Janice R. Long and David J. Hanson, C&EN Washington

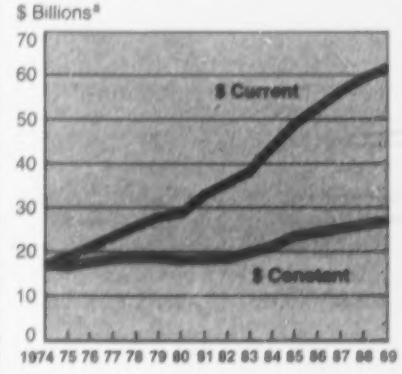
In the fiscal 1989 budget proposal that President Reagan sent to Congress on Feb. 18, funding for scientific research holds its own in a federal budget that rises 4% to $1.094 trillion (C&EN, Feb. 22, page 4). In the proposal, total R&D obligations are up 4% from fiscal 1988, or $2.6 billion, to $62.5 billion, with obligations for basic research up 6%, or $617 million, to $10.3 billion. Obligations for R&D facilities, which are not included in those amounts, are up 6% to $2.1 billion.

If Congress agrees to those numbers without making any changes—and that's unlikely—it means that federal R&D funding has increased some 240% over the past 15 years. Even adjusted for inflation that growth is impressive: In constant-dollar terms, R&D funding has increased more than 45% from $17.4 billion in 1974 to $25.5 billion in 1989.

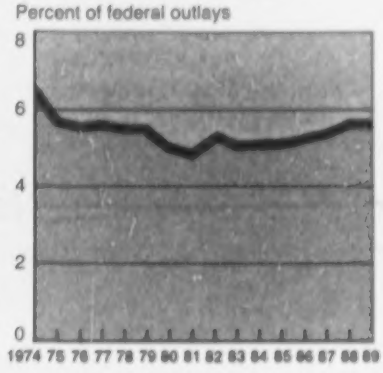
That growth is shared by almost all of the major federal research agencies. Based on the proposed 1989 figures, funding for defense R&D, including the Department of Energy's work, has grown 81% since 1974 to $17 billion in constant-dollar terms, 87% for the National Institutes of Health to $2.6 billion, 41% for energy R&D to $1.2 billion, and 30% for the National Science Foundation to $700 million. However, R&D funding for the National Aeronautics & Space Administration has dropped 35% in real terms to $2.1 billion.

Because the recently submitted budget is the final one on which Reagan will have a direct impact, it's now possible to trace R&D funding during his entire Administration—fiscal years 1982 through 1989. It's a fairly consistent pattern, given the Administration's emphasis on defense and basic research as opposed to applied research and development, which it feels is best done by the private sector. During the Reagan years, total R&D has increased 36% in terms of constant 1974 dollars. Funding for defense R&D has risen

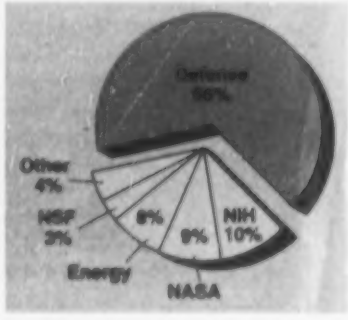
Proposed R&D budget shows little real growth . . .



. . . but R&D still takes nearly 6% of outlays . . .



. . . and defense accounts for largest share of total R&D



[a] Obligations. **Source:** Office of Management & Budget

Glossary of budget terms

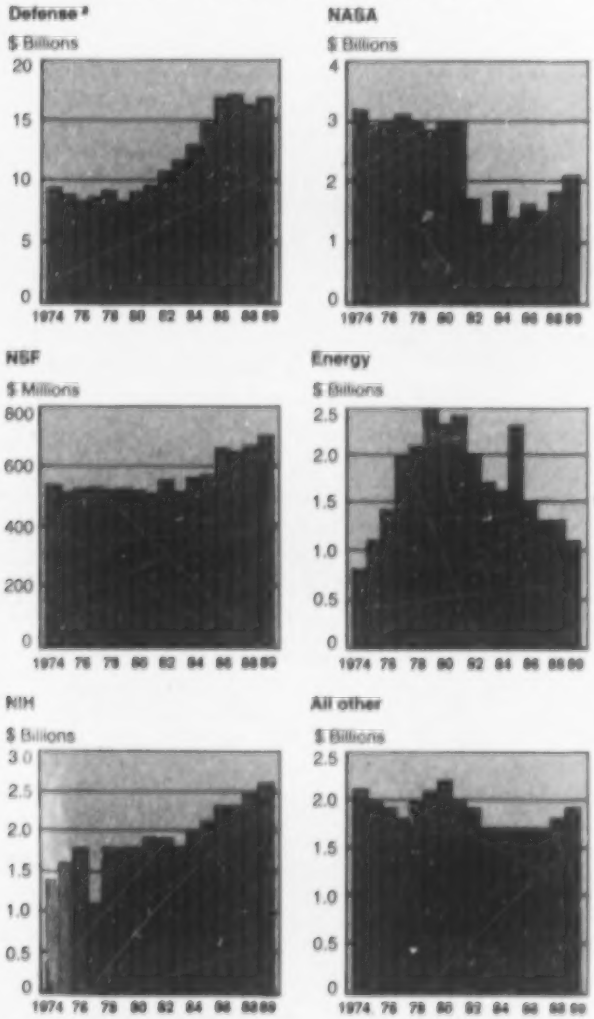
Fiscal year. Year running from Oct. 1 to Sept. 30. The fiscal year is designated by the calendar year in which it ends.

Obligations. Commitments made by federal agencies to pay out money for products, services, or other purposes, as distinct from the actual payment.

Outlays. Payments for obligations incurred under Congressionally granted budget authority generally made by issuance of checks on the Treasury. Outlays during any fiscal year may be for obligations incurred in prior fiscal years or in the same fiscal year.

Note. The R&D numbers obtained from individual agencies frequently differ from those used by the Office of Management & Budget in preparing its analysis of total federal R&D funding.

Since 1974, defense R&D has grown more than 80%, health research almost 90%



Note: Outlays in constant 1974 dollars. a Includes Department of Defense and Department of Energy programs. **Source:** Office of Management & Budget

59%, NIH 43%, NSF 27%, and NASA 19%. However, funding for energy R&D has declined 43%, primarily because of cutting large demonstration projects, and funding also has fallen for agricultural research, down 5% to $357 million, and for natural resources and environmental R&D, down 13% to $394 million.

With the 1989 budget proposal, the rapid expansion in defense R&D has been halted, at least temporarily. The Administration has requested the smallest increase in Department of Defense R&D in many years, reflecting the restraints set by the bipartisan budget agreement worked out between Congress and the Administration in November of last year. That agreement called for a 2% cap on increases in discretionary domestic spending and a 2.6% cap on military spending. DOD's R&D budget isn't rising by even that much. With only a 2% rise from fiscal 1988 in overall obligations, to $38.0 billion, most programs are maintained at their current levels. Still, DOD's spending equals about 60% of all federal R&D funding proposed for fiscal 1989.

In the new budget, the research end of DOD's research, development, test, and evaluation programs—called technology base and advanced technology development—gets a slight increase to $3.3 billion, from $3.1 billion in 1988. The Administration says two of the areas receiving increased emphasis this year are materials research and electronics. Two other areas getting high priority are "very high speed integrated circuits" and "millimeter wave monolithic integrated circuits."

In the advanced technology area, most of the 15% increase, $855 million, is going to the President's controversial program for protection against nuclear missiles, the Strategic Defense Initiative, for which a total of $4.6 billion is requested. SDI has not fared well, however, at the hands of Congress. The Administration's requests have always been cut sharply. Last year, for instance, the request was for $5.2 billion, but Congress approved just $3.6 billion. It's a good bet that the programs will be trimmed back to less than $4 billion again for 1989.

The biggest part of the DOD development budget goes primarily for technology evaluation and testing of major tactical weapons systems. With more than a third of the total R&D request at $13 billion, tactical programs obviously include the big ticket items. Some projects that will be emphasized in fiscal 1989 include advanced antitank weapons for the Army, new tilt-rotor aircraft development and antisubmarine warfare capabilities for the Navy, and work on munitions for hardened targets and various electronic warfare programs for the Air Force.

A feeling of déjà vu comes from development of launching equipment for the nearly complete MX, or Peacemaker, missile. Funds are being sought for development of a railroad garrison basing for the missile, a plan that had been debated heavily and rejected during the Carter Administration.

Apparently not affected by the budget ceiling agreed to in November is the Department of Health & Human Services, which puts almost all of its R&D money

TOTAL FEDERAL R&D BUDGET PROPOSAL

Obligations for R&D are up just 4% . . .

$ billions	Obligations			Outlays		
	1988[a]	1989[a]	1987[b]	1988[a]	1989[a]	1987[b]
Defense	$36,787	$37,899	$35,086	$37,023	$33,776	$34,561
Health & Human Services	7,938	7,174	6,643	7,446	6,561	5,733
NASA	5,416	4,779	3,787	4,820	3,962	3,250
Energy	5,185	5,071	4,724	5,062	4,941	4,662
NSF	1,627	1,524	1,464	1,618	1,492	1,410
Agriculture	985	1,018	946	961	966	921
Interior	396	419	403	393	420	389
EPA	374	360	348	335	340	326
Transportation	317	325	322	341	352	324
Commerce	312	408	405	333	360	306
Veterans Administration	216	216	210	202	209	195
Agency for International Development	199	206	223	196	243	230
All other	585	560	527	563	539	513
TOTAL	$62,517	$59,951	$56,090	$59,315	$54,163	$52,662

a Estimate. b Actual. Source: Office of Management & Budget

. . . and basic research is up 6% . . .

$ billions	Obligations			Outlays		
	1988[a]	1989[a]	1987[b]	1988[a]	1989[a]	1987[b]
Health & Human Services	$4,260	$4160	$3859	$4204	$3787	$3262
NSF	1,734	1439	1382	1526	1404	1329
NASA	1,374	1229	1014	1223	1017	856
Energy	1,265	1185	1061	1259	1175	1040
Defense	906	892	904	874	837	844
Agriculture	470	471	446	450	443	430
Interior	125	131	124	125	132	121
Smithsonian Institution	77	77	72	73	76	70
EPA	31	32	31	27	30	30
Commerce	27	27	26	26	25	26
Veterans Administration	18	18	17	18	16	16
All other	16	27	27	21	30	27
TOTAL	$10,305	$9868	$9993	$9825	$8952	$8960

a Estimate. b Actual. Source: Office of Management & Budget

. . . as are funds for R&D facilities

$ billions	Obligations			Outlays		
	1988[a]	1989[a]	1987[b]	1988[a]	1989[a]	1987[b]
Energy	$1132	$ 939	$ 776	$1026	$ 918	$ 723
NASA	549	429	309	479	386	314
Defense	191	267	316	176	239	235
Agriculture	66	126	112	99	108	71
NSF	67	56	64	56	54	50
Health & Human Services	6	70	36	34	44	32
All other	58	75	63	57	65	39
TOTAL	$2068	$1961	$1676	$1927	$1811	$1464

a Estimate. b Actual. Source: Office of Management & Budget

into NIH. Last year, the Administration tried some accounting high jinks that effectively lowered the amount of research spending available to the huge biomedical establishment. However, Congress didn't go along with that idea, and so the proposed budget for 1989 is more straightforward. On paper, the HHS R&D budget is up 11% from 1988 to $7.9 billion, with the total NIH budget up 18% to $7.8 billion, but total funding for the individual institutes is down 1% to $6 billion.

That will probably not be the case, because the Administration has pulled all of the funding for research on acquired immune deficiency syndrome (AIDS) out of each institute's budget and is asking instead for the funding in a separate account. More than $900 million of the $1.3 billion requested for AIDS research is expected to go to NIH.

Because AIDS research is now a separate line item, the budgets of some of the institutes, particularly Allergy & Infectious Diseases, appear to be sustaining large cuts. AIDS money presumably will flow back to these institutes, but how much is not indicated by the budget. In fiscal 1989, the Administration says NIH will be able to fund up to 21,000 research project grants and about 11,000 research trainees.

Unlike NIH, other research-supporting agencies within HHS get substantial cuts in their budgets. R&D funding for the Alcohol, Drug Abuse & Mental Health Administration, which got $561 million for R&D in 1988—mostly for clinical work on drug abuse and neurological disorders—is down to $522 million. For the Food & Drug Administration, which does only a little research relative to drug and food additive regulations, R&D funding is down 3% to $88 million. The Centers for Disease Control, which is responsible for much of the major epidemiologic research and health promotion in the U.S., is slated for a 12% cut in its R&D budget to $63 million.

Increased Administration emphasis on the space program this year has netted NASA its biggest proposed increase in many years with a total budget nearing $11.5 billion, about 40% of which is set aside for conduct of R&D. That $4.4 billion represents a 16% increase over fiscal 1988 appropriations. Most of the increase is expected to go to hardware development and plans for the space station. With a budget of almost $1 billion next year, an 87% increase over 1988, the space station is touted as an indispensable base for future manned lunar and Mars expeditions, either by the U.S. alone or in cooperation with other countries.

Many of the other programs NASA hopes to carry on depend on the resumption of space shuttle flights. Thus, some of NASA's fiscal 1989 R&D funds are going to the development of better expendable launch rockets, including a new advanced solid rocket motor for the shuttle. Flights are now scheduled to begin again in August, and NASA says it plans for seven missions to be flown in fiscal 1989 and maybe 10 in 1990. This schedule will allow for the launching of many of the astronomy and planetary missions NASA has had to postpone over the past two years.

Unlike HHS and NASA, the Department of Energy doesn't get an exemption from the November budget

DOE: Basic energy research big gainer

$ Millions	1989	1988	% change 1988–89
Defense R&D	**$2544.3**	**$2511.9**	1%
Weapons R&D, testing	1914.3	1904.9	0
Naval reactors development	630.0	607.0	4
Energy R&D	**3189.0**	**3100.6**	3
Basic science research	1713.3	1367.2	25
Supporting research activities	382.5	389.9	−2
Magnetic fusion	360.0	335.0	7
Nuclear energy	354.0	349.2	1
Fossil energy	168.0	354.1	−53
Renewable energy	124.9	149.0	−16
Conservation	86.3	156.2	−45
TOTAL	**$5733.3**	**$5612.5**	2%

Note: DOE has reorganized its R&D budget; comparable 1987 figures are not available; all numbers are estimates; obligations. **Source:** Department of Energy

NSF's total budget is up 19%. . .

$ Millions	1989[a]	1988[a]	1987[b]	% change 1988–89
Mathematical and physical sciences	$ 502.8	$ 473.0	$ 464.7	6%
Geosciences	320.9	291.3	285.2	10
Biological, behavioral, and social sciences	288.7	266.0	259.3	9
Engineering	195.0	171.5	163.1	14
Science and engineering education	156.0	139.3	99.0	12
Science and technology research centers[c]	150.0			
Computer and information science and engineering	149.1	123.9	116.9	20
Antarctic program	141.0	124.8	117.0	13
Program development and management	95.5	84.5	77.8	13
Scientific, technological, and international affairs	51.0	44.0	43.8	16
TOTAL	**$2050.0**	**$1718.3**	**$1626.8**	19%

Note: Obligations. a Estimate. b Actual. c New program. **Source:** National Science Foundation

. . .while funding for the sciences is up 8%. . .

$ Millions	1989[a]	1988[a]	1987[b]	% change 1988–89
Ocean sciences	$ 146.5	$135.4	$133.7	8%
Physics	126.7	118.2	117.0	7
Materials research	118.9	110.9	108.9	7
Atmospheric sciences	104.2	96.3	93.5	8
Chemistry	99.2	94.3	93.8	5
Astronomical sciences	90.0	86.0	85.0	5
Mathematical sciences	68.0	63.7	59.9	7
Biotic systems, resources	65.3	59.0	58.3	11
Earth sciences	59.3	51.3	49.9	16
Cellular biosciences	57.6	54.2	53.8	6
Molecular biosciences	48.3	44.6	44.2	8
Behavioral, neural sciences	46.5	43.8	43.3	6
Social, economic sciences	32.6	30.1	31.2	8
TOTAL	**$1063.1**	**$987.8**	**$972.5**	8%

Note: Obligations. a Estimate. b Actual. **Source:** National Science Foundation

. . . and for chemical programs up 7%

$ Millions	1989[a]	1988[a]	1987[b]	% change 1988–89
Chemistry	**$ 99.2**	**$ 94.2**	**$ 93.9**	5%
Physical	28.5	28.0	28.2	2
Organic and macromolecular	22.8	22.4	22.4	2
Inorganic, bioinorganic, and organometallic	14.7	14.3	14.4	3
Analytical and surface	12.3	12.0	11.9	3
Special projects	12.0	9.1	7.1	32
Instrumentation	8.9	8.4	9.9	6
Materials research	**79.2**	**73.3**	**70.7**	**8**
Laboratories	26.9	26.2	26.6	3
National facilities	12.8	11.3	11.2	13
Solid-state chemistry	9.2	8.7	8.5	6
Materials research groups	8.9	7.4	6.0	20
Polymers	8.7	8.0	7.0	9
Ceramics and electronic materials	8.2	7.7	6.5	6
Instrumentation	4.5	4.0	4.9	13
Chemical, biochemical, and thermal engineering	**31.9**	**29.0**	**28.4**	**10**
Thermal systems	8.5	8.0	8.0	6
Interfacial, transport, and thermodynamic processes	5.6	4.7	4.6	19
Process and reaction engineering	4.0	3.7	3.6	8
Particulate and multiphase processes	3.6	3.3	3.3	9
Kinetics and catalysis engineering	3.5	3.2	3.1	9
Biochemical and biomass engineering	3.4	3.0	2.8	13
Separation and purification processes	3.3	3.1	3.0	6
Biochemistry	**14.0**	**13.3**	**13.7**	**5**
TOTAL	**$224.3**	**$209.8**	**$206.7**	7%

Note: Obligations. a Estimate. b Actual. **Source:** National Science Foundation

AIDS accounts for gains in health research

$ Millions	1989[a]	1988[a]	1987[b]	% change 1988–89
National Institutes[c]	**$6051.5**	**$6081.8**	**$5677.5**	−1%
Cancer	1468.3	1469.3	1402.8	0
Heart, Lung & Blood	1015.5	965.5	930.0	5
General Medical Sciences	676.7	632.7	570.9	7
Diabetes & Digestive & Kidney Diseases	562.3	534.7	511.1	5
Neurological & Communicative Disorders & Stroke	557.6	534.7	490.2	4
Allergy & Infectious Diseases	435.1	638.8	545.5	−32
Child Health & Human Development	397.9	396.8	366.8	0
Eye	229.0	224.9	216.6	2
Environmental Health Sciences	218.9	215.7	209.3	1
Aging	204.8	194.7	177.7	5
Arthritis & Musculoskeletal & Skin Diseases	158.2	147.7	138.7	7
Dental Research	127.2	126.3	117.9	1
AIDS[d]	**1300.0**			
Research Resources	**320.0**	**368.2**	**322.9**	−13
National Library of Medicine	**70.6**	**69.6**	**61.8**	1
Center for Nursing Research	**24.4**	**23.4**	**20.0**	4
John E. Fogarty Center	**11.3**	**15.7**	**11.4**	−28
Research facilities	**5.0**	**47.9**	**31.9**	−90
TOTAL	**$7782.8**	**$6606.6**	**$6125.5**	18%

Note: Obligations. a Estimate. b Acutal. c Funds for AIDS research have been deleted from all Institutes and collected in the AIDS funding category. d Includes all Health & Human Services spending on AIDS, not just research. **Source:** Office & Management & Budget

Defense increase smallest under Reagan

$ Millions	1989[a]	1988[a]	1987[b]	% change 1988–89
Conduct of R&D	**$37,880**	**$37,009**	**$34,877**	**2%**
Tactical programs	13,008	12,509	10,761	4
Strategic programs	6,605	7,162	7,817	−8
Advanced technology development	6,389	5,534	4,855	15
Intelligence and communications	4,499	4,797	4,802	6
Program management and support	4,068	3,866	3,825	5
Technology base	3,311	3,141	2,817	5
R&D facilities	**191**	**267**	**318**	**−28**
TOTAL	**$38,071**	**$37,276**	**$35,195**	**2%**

Note: Obligations. a Estimate. b Actual. **Source:** Office of Management & Budget

Space R&D moves ahead with new vigor

$ Millions	1989[a]	1988[a]	1987[b]	% change 1988–89
Conduct of R&D	**$4382.7**	**$3793.3**	**$2943.5**	**16%**
Space station	938.6	502.0	309.5	87
Physics and astronomy	782.3	678.3	545.6	15
Space capability development	624.5	641.5	461.8	−3
Space applications	562.3	730.8	554.4	−23
Aeronautical research	409.9	358.2	382.4	14
Planetary exploration	400.3	350.3	346.2	14
Space research & technology	382.4	285.8	168.9	34
Life sciences	100.1	70.7	71.3	42
Transatmospheric vehicle	82.8	52.0	42.9	59
Commercial programs	58.7	88.3	31.9	−34
Safety & quality assurance	22.0	17.1	10.7	29
Tracking & data acquisition	18.8	18.3	17.9	3
R&D facilities	**285.1**	**178.3**	**217.4**	**60**
TOTAL	**$4667.8**	**$3971.6**	**$3160.9**	**18%**

Note: Obligations. a Estimate. b Actual. **Source:** Office of Management & Budget

Agriculture research is down 8%

$ Millions	1989[a]	1988[a]	1987[b]	% change 1988–89
Agricultural Research Service	$577.0	$ 603.5	$ 522.3	−4%
Cooperative State Research Service	257.5	306.3	379.5	−16
Forest Service research	129.3	135.5	126.7	−5
National Agricultural Library	13.6	12.2	11.1	11
TOTAL	**$977.4**	**$1057.5**	**$1039.6**	**−8%**

Note: Obligations. a Estimate. b Actual. **Source:** Department of Agriculture

EPA research increases 6%

$ Millions	1989[a]	1988[a]	1987[b]	% change 1988–89
Air	$ 72.5	$ 65.8	$ 63.1	10%
Superfund/underground tanks	67.6	59.2	40.6	14
Energy/acid rain	55.4	55.6	62.6	0
Hazardous waste	41.3	44.7	49.8	−8
Interdisciplinary	34.1	26.9	27.5	27
Toxic substances	26.6	26.8	31.0	−1
Water quality	25.1	24.8	25.1	1
Drinking water	22.0	22.5	22.8	−2
Pesticides	14.4	12.9	12.7	12
Management & support	11.8	10.1	11.0	17
Radiation	4.0	2.9	2.6	38
TOTAL	**$374.8**	**$352.2**	**$348.8**	**6%**

Note: Obligations. a Estimate. b Actual. **Source:** Environmental Protection Agency

ceiling agreement. Its total R&D budget at $5.7 billion is up the agreed upon 2%. The agency's budget for defense research programs is up just 1% to $2.5 billion, and that for energy research is up 3% to $3.2 billion. In addition, DOE will be spending $525 million that Congress already has appropriated on demonstration projects for innovative clean-coal technologies.

Among research programs whose budgets are down is basic energy sciences, funding for which is down 14%, or $62 million, to about $376 million, at least on paper. The cut is more than accounted for by DOE's continued refusal to ask for more funding for Congressionally initiated projects that the department doesn't want in the first place. Those account for some $73 million, which leaves room for increases in the programs DOE does want to support.

For example, operating expenses for the chemical portion of basic energy sciences programs, following an 11% increase in fiscal 1988, are up 6%, or $5 million, to $93.1 million in fiscal 1989. Just over 65% of that total supports work at national laboratories, and 31% supports university research. Funding for material sciences research is up 7%, or $8.6 million, to $135 million, following a 6% increase this year. Just under 75% of that budget goes to support work at national laboratories, with universities getting 24%.

Funding for DOE's basic research user facilities is soaring 69%, or $398 million, to $973 million, primarily because of the $363 million requested for construction and R&D on the Superconducting Super Collider. DOE says that "with continued funding as planned, the project can be completed in 1996."

However, funding for DOE university research support is not soaring. In fact it's down 14% to $15.8 million, and funding for university research instrumentation remains unchanged at $5 million. Even harder hit is funding for fossil energy R&D, down 53% to $168 million, and for conservation R&D, down 45% to $86.3 million. Congress has always refused to go along with cuts of this magnitude, but both budgets have slipped considerably over the past several years.

The budget request for NSF puts it back on track toward its goal of doubling funding over five years. The total budget is up 19%, or $332 million, to $2.1 billion. Obviously, NSF has the support of the Administration for its efforts, but it remains to be seen if Congress will also support it. NSF initiated this program last year with a requested increase of 17% for fiscal 1988. It got just 6%, or $91 million, and $40 million of that went to science education, leaving the research programs with a bare 3% increase.

For fiscal 1989, NSF wants a 10%, or $149 million, increase to $1.6 billion for its research programs. In addition, it is seeking $150 million for its new science and technology centers program as a separate line item in the budget. NSF says that this amount would provide upfront funding for about 15 centers for periods of up to five years. If that amount is factored into the research budget proposal, the resulting increase is 20%.

NSF points out that "because of the severe constraints imposed by Congressional reductions to the fiscal 1988 budget request, increases in award sizes,

with few exceptions, were not possible, although support for graduate students through these awards was protected to the maximum extent." The reductions also forced deferral of needed purchase, upgrade, and maintenance of equipment. With the increase provided in the fiscal 1989 request, NSF says, attention will again be focused on individual investigator award size, support of students and technicians, and provision of needed equipment.

However, the NSF budget largesse doesn't extend to the chemistry division. Its budget is up only 5%, or $5 million, to $99.2 million. That comes after the less than 1%, or $436,000, increase it got for the current fiscal year. Within the division, funding for the traditional disciplines is up about 2%. Instrumentation monies are up 6%, which may not be enough to provide much support for the new initiative on funding of long-term maintenance and support for expensive instruments. However, funding for special projects is up 32%, or $3 million, to $12 million. This will allow the division to broaden the scope of its materials chemistry initiative as well as that of chemistry of life processes. Increases are also planned to fund the second year of the three-year postdoctoral fellowship program. And some money may well be available for chemical research from the science and technology centers account, if it is applied for.

Research spending by the Department of Agriculture's Agricultural Research Service is slightly higher in fiscal 1989, although a big cut in funds available for construction of buildings and facilities actually makes the total R&D budget about 4% less than in 1988. Budgets are also down for the Cooperative State Research Service and Forest Service research. Research on environmental concerns surrounding the use of pesticides gets significant increases in funding, including about $9.5 million in funds earmarked for reducing pesticide residues in foods, improving groundwater quality, and improving pesticide application methods. In addition, $700,000 is available for assessing the effect of reductions in stratospheric ozone on major crops.

Research grants administered through USDA's Cooperative State Research Service are increased 28% to more than $54 million, but work performed at a variety of federal research centers is zeroed out in the new budget. Research funds for work on animal health and disease, aquaculture, international trade issues, and productivity—amounting to nearly $50 million in cuts—at universities and colleges are eliminated on the basis that it can be done better through competitive grants.

Forest service competitive grants are also eliminated and other work reduced, cutting about $6.2 million from the research budget. Support continues for areas such as forest management, ecosystems interaction, insect and disease breakouts, and international trade and competitiveness.

Overall research funding at the Department of Interior is down 5%, or $23 million, to $396 million. Geological Survey research funding is down 5%, or $12 million, to $224 million. The remaining resources are devoted to, among other things, new improved methods of mineral exploration and improving the scientific basis for appraisal and evaluation of water resources. The research budget for the Bureau of Mines is down 10%, or $10 million, to $86 million, and for the Fish & Wildlife Services the budget is down about 7%, or $4 million, to $54 million.

At the Environmental Protection Agency, R&D has always had to take a backseat to the regulatory mandates set by Congress in the various environmental laws. The result sometimes has been wide-reaching regulations based on incomplete or even incorrect technical data. For fiscal 1989, R&D continues to be a small part of EPA's budget, although the President has proposed some increase.

Of the agency's total budget of nearly $3.3 billion (including administration of Superfund), $375 million is earmarked for R&D. This represents a 6% increase from fiscal 1988 spending of $352 million, but no major changes in direction for the agency. Unlike other R&D programs that have no specific goals, much of EPA's research is directed to meeting specific regulatory needs. As these are met, one program is slowed, and another takes its place. In 1989, research on drinking water is being reduced, for instance, reflecting the completion of toxicological testing of priority pollutants under the Safe Drinking Water Act. Funds for research on hazardous wastes are cut, but they really have been moved into the Superfund category, where they will be directed to devising better cleanup techniques for abandoned waste sites.

The greatest R&D spending by EPA continues to be in air research. Much of the research is aimed at expansion of work on stratospheric ozone depletion, but there will be some forward-looking research on the problems of global warming and assessing the risks of indoor air pollution. Research on radiation problems had almost been eliminated a few year ago, but because of the emphasis placed on radon leaking into homes, EPA has added more than $1 million for radon reduction technology demonstrations and measurements. EPA Administrator Lee M. Thomas says one of the agency's priorities in research this year is the reduction of uncertainties in human health risk assessments. Funded in the interdisciplinary category, about $10 million is devoted to giving a truer picture of health risks posed by environmental factors.

Research at the Department of Commerce is down sharply, almost 25%, or $96 million, to $312 million. Cuts in the National Oceanic & Atmospheric Administration's R&D budget account for more than the total reduction in the department's R&D budget; it is down $102 million, or 35%, to $180 million. This reduction is to be achieved by eliminating low-priority research programs such as seafloor spreading research, the national underseas research program, and the national Sea Grant College program. NOAA will devote $15 million to research to improve predictions of global climate change and maintain its acid rain research at current levels. The research budget for the National Bureau of Standards, also part of Commerce, is up 9%, or $10 million, to $120 million. □

Profits Rise Sharply For Canadian Chemical Companies

1987 ends with flourish for four major chemical firms, with combined earnings up 70% on combined sales rise of 20% in fourth quarter

"Best ever." "Record earnings." Those are the phrases that spice the 1987 fourth-quarter and annual earnings statements flowing out of the happy headquarters of many Canadian chemical companies.

For most of the Canadian chemical industry, 1987 was, indeed, a very good year. The notable exception, as in the past several years, is the fertilizer segment, and even that is starting to show some signs of improvement.

Chemical company profits benefited from a strong domestic economy, higher chemical exports, and long-awaited firmer prices. And the belt-tightening that most Canadian chemical companies put into practice during the lean years only a short time ago really paid off last year.

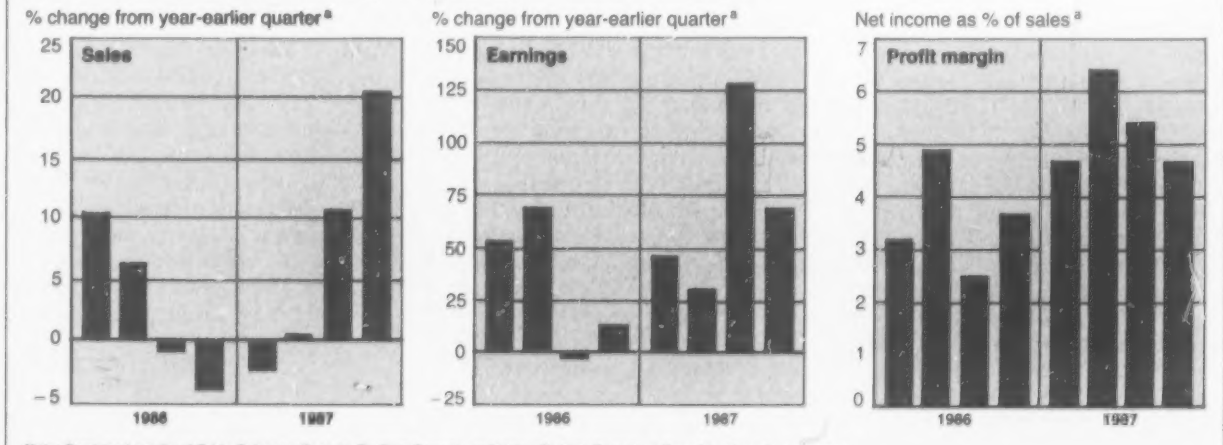
Even the stock market crash last October failed to make much of a dent in the fortunes of Canada's chemical industry. Fourth-quarter chemical sales were the highest of any quarter in the year. And profits rose a healthy 70% over the fourth quarter of 1986.

That, at least, is how the industry looks, based on combined results of the four large, publicly traded Canadian chemical companies tracked by C&EN. These companies are C-I-L, Celanese Canada, Du Pont Canada, and Union Carbide Canada. The cost-cutting measures and rationalization program implemented by Canadian chemical companies were particularly effective last year. For instance, combined sales of these four companies rose a respectable 20% to $711 million (all figures in U.S. currency; $1.00 = $1.311 Canadian) in the fourth quarter, but profits increased an even better 70% to $33.2 million. The story is the same for the entire year: sales up 6.7% to $2.61 billion ($1.00 = $1.324 Canadian) and profits up 55% to $139 million.

Of the four major firms, C-I-L turned in the most dramatic improvement last year, only in part because 1986 was not a particularly strong year for comparison. In 1986, C-I-L's net income dropped a hefty 49% from the previous year. Last year, it advanced an eye-opening 100%. The story is equally dramatic for the fourth quarter, when sales jumped 22% to $270 million and profits soared 700% from fourth-quarter 1986 to $6.1 million.

The company credits not only the economic recovery in several of its key markets, but a "growing payback" from the improvements in productivity and cost-reduction measures that it has implemented. For the entire year, sales were higher for all of the company's business units, with the usual exception of fertilizers. However, even fertilizer sales increased 16% in the fourth quarter.

Canadian chemical earnings shoot up faster than sales



Note: Combined results of C-I-L, Celanese Canada, Du Pont Canada, and Union Carbide Canada. [a] Based on Canadian currency

Canadian firms finish 1987 on a strong note

$ Millions[a]	Net sales	Change from 1986[b]	Net income[c]	Change from 1986[b]	Profit margin[d] 1987	Profit margin[d] 1986
FOURTH-QUARTER 1987						
C-I-L	$270.1	22.1%	$ 6.1	700.0%	2.3%	0.3%
Celanese Canada	77.4	10.3	6.8	67.9	8.8	5.8
Du Pont Canada	273.6	18.8	14.3	29.7	5.2	4.8
Union Carbide Canada	89.4	29.2	6.0	61.7	6.7	5.4
TOTAL	$710.7	20.2%	$33.2	69.7%	4.7%	3.3%
FULL-YEAR 1987						
C-I-L	$1011.7	3.9%	$ 30.2	100.0%	3.0%	1.6%
Celanese Canada	265.2	1.7	21.4	51.1	8.1	5.5
Du Pont Canada	1012.5	7.9	68.4	50.0	6.8	4.9
Union Carbide Canada	318.0	17.3	19.4	27.2	6.1	5.6
TOTAL	$2607.4	6.7%	$139.4	54.7%	5.4%	3.7%

a $1.00 = $1.311 Canadian (fourth quarter) and $1.324 Canadian (full year). b Based on Canadian currency. c Based on continuous operations and excluding extraordinary items. d Net income as percentage of sales.

For Celanese Canada, recently appointed president Paul H. Williams says that 1987 represented "the best performance in the company's 62-year history." Net income was up 51% from the previous year to $21.4 million on sales of $265 million, which were only 1.7% higher. He says that the strong improvement in earnings of the chemicals and industrial products group was responsible for much of the company's higher profitability. Volume and prices were higher in both domestic and export markets. At the end of the year, all plants were operating at full capacity. Fourth-quarter earnings increased 68% to $6.8 million on sales up 10% to $77.4 million.

Du Pont Canada also enjoyed record earnings in 1987, which president J. E. Newall attributes to a combination of higher sales volume, "modestly higher" selling prices, and "slightly lower" raw material costs. Together, these factors more than offset higher fixed costs and selling expenses.

Du Pont Canada's earnings rose 50% last year to $68.4 million, even though sales increased only 7.9% to just over $1 billion. Demand was exceptionally good for carpet fibers, specialty industrial fibers, engineering resins, and other high-performance plastics, Newall says. Earnings in the fourth quarter rose 30% to $14.3 million; sales, 19% to $274 million.

Union Carbide Canada also enjoyed a banner year in 1987. Sales were up 17% to $318 million and net income advanced 27% to $19.4 million. Fourth-quarter earnings climbed 62% to $6.0 million on sales up 29% to $89.4 million. Chemicals and industrial gases led the sales and earnings gains.

Canadian chemical executives are generally optimistic about 1988. However, any economic slowdown will prevent the industry from repeating last year's stellar performance. This doesn't mean that profits will not increase. It only means that the increase will not be so great as it was last year. Still, most Canadian chemical companies are in good shape to cope with an economic slowdown.

One factor that could hurt profits in the Canadian chemical industry is the growing strength of the Canadian dollar against the U.S. dollar. It now stands at 1.27 to the U.S. dollar, strengthening 8% in the past year. Some economists think that Canadian companies might be hurt if the Canadian dollar remains at this level. And there are signs that it could strengthen even more.

This could hurt Canadian chemical companies because about 62% of Canada's chemical exports move into the U.S., where a stronger Canadian dollar would make it tougher for them to compete against U.S. companies. Even those Canadian exports shipped to other parts of the world would find it more difficult to compete against U.S. companies exporting to the same destination.

Earl Anderson, New York

Sealants market to hit $2.3 billion by 1991

The U.S. market will consume some 1.5 billion lb of sealants worth $2.3 billion by 1991, according to a market report just released by Freedonia Group, a Cleveland-based business research organization.

The report puts U.S. consumption in 1986 at 1.3 billion lb, valued at $1.7 billion, and predicts a 2.8% per year growth rate between 1986 and 1991.

Fueling industry growth will be demand for new synthetic materials such as polyurethanes, silicones, epoxies, and fluorocarbons. The report predicts that demand for these sealants will grow nearly 7% per year through 1991. Older synthetics, such as synthetic rubbers, polysulfides, and acrylics, will exhibit about average growth—2 to 3%—through 1991. Demand for natural material sealants, such as linseed and oleoresinous compounds, however, will change little, if any, through the 1990s.

The new synthetic sealants are expected to do so well because of new applications and because of decreasing prices for the group. The older synthetics group continues to gain popularity while giving good performance at moderate price, according to the report. Natural sealants growth will be limited to existing uses, though they will remain the largest category because of their low cost.

The industrial market for all sealants will grow 3.4% per year through 1991, the report says, reaching 400 million lb that year; followed by the consumer market, which will grow 2.8% per year, reaching 480 million lb; and the construction market, which will grow 2.6% per year, reaching 630 million lb.

The resources of many small sealants firms will be strained by environmental issues, regulatory constraints, and enforced contributions to waste disposal programs, the report points out.

The 62-page report is available from Freedonia Group, 2940 Noble Rd., Suite 200, Cleveland, Ohio 44121, at a cost of $800.

Marc Reisch, New York